HONEYBEES

Increase Clover Seed Production

By

D F. BEARD, *Extension Agronomist*
W. E DUNHAM, *Insect Pollination Specialist*
C A REESE, *Extension Apiarist*

One bushel of red clover seed will produce under favorable conditions—
12 tons of 16 per cent protein feed, and
400 pounds of residual nitrogen; enough to produce 100 to 125 extra bushels of corn.

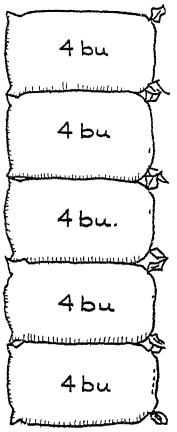
The value of legumes to a permanent and efficient agriculture, therefore, demands an adequate annual seed supply to plant the millions of acres of cultivated crop land that depend upon legumes for the maintenance of soil productivity.

Efficiency in the production of legume seeds is the keystone to ample acreages of these soil-builders.

Insect Pollination Vital Factor in Increasing Seed Yields

Alsike, medium red, white Dutch and Ladino clovers are practically self-sterile, and are dependent upon insect pollination to insure cross-pollination and subsequent seed set. Sweet clover, mammoth red clovers, and alfalfa vary in their degree of self-fertility, but in all cases are dependent on insect pollination to insure self- and cross-pollination so necessary for profitable seed yields. The flower structure of all these legumes makes *wind* pollination a negligible factor.

Fig. 1.—Seed Yields Occurring with Favorable Cultural, Soil, and Weather Conditions



← 20 bu. Alsike Clover seed per acre, with maximum insect pollination

← 12 bu. Red Clover seed per acre, with maximum insect pollination

← 8 bu. Alsike Clover seed, PRACTICAL, with dense honeybee population

← 4 bu Red Clover seed—PRACTICAL

10-YEAR AVERAGE FOR OHIO:
Alsike Clover seed per acre, 1.6 bu.
Red Clover seed per acre, 1 bu.

The size of the pollination job for an acre of legume bloom is much larger than most of us realize. For example, an acre of alsike or red clover blooms contains 400,000,000 or 216,000,000 individual florets respectively. To have 100 per cent pollination occur each floret must be visited by a pollinating insect. Under field conditions this would seldom happen. However, under experimental conditions where 100 per cent pollination took place with alsike clover, yields varying from 12½ to as high as 20 bushels of seed an acre have occurred.

Legume Pollinating Insects

The legume pollinating insects may be classed in two groups, namely: the wild pollinating insects over which we have little control; and the honeybee—the only controlled pollinating insect. The uncontrolled pollinating insects, which play a meager role in legume pollination, are exemplified by the bumblebees, solitary bees, flies, butterflies and moths. In 43 hours of collecting wild pollinating insects on alsike bloom in various counties, only an average of 9 insects were collected per hour. Where honeybees are plentiful, from 200 to 300 can be found in an hour.

The honeybee represents the only controlled pollinating insect and is ideally adapted to accomplish the pollination job. Its social organization makes possible the development of enormous colonies which may be placed in any desired location in the numbers necessary. The instinct of the honeybee to gather nectar and pollen, along with its behavior of working every hour of the day when weather permits, are assets which very few other insects possess.

By skillful bee management it is possible to build the bee population of each colony to over 80,000 worker bees by the clover blooming season, and these colonies can be stimulated to deliver maximum pollinating services.

The density of the honeybee population and its constancy over a period of years should be of much concern to farmers. For each dollar that the beekeeper receives, fifteen to twenty dollars' worth of pollination services are returned to agriculture. As long as farmers receive free pollinating services there is only one factor which will insure an adequate honeybee population, namely, the profitableness of honey production to beekeepers. It is of real economic interest that the density of the honeybee population increase as much as possible. Yet, at the same time those bees should return profitable honey and beeswax yields to the beekeeper.

Table 1.—Ohio Studies on Insect Pollination of Alsike Clover. Seed Yields in Terms of Bushels per Acre (By W. E. Dunham)

Year	County	Cage Tests			Field Tests	
		Self-pollination where all pollinating insects *were* excluded from bloom	Self-pollination + wind pollination. All pollinating insects excluded from bloom	With maximum insect pollination—honeybees	Natural pollinating insects + very few honeybees	Natural pollinating insects + honeybee populations of varying concentrations
1936..	Wood	.25		20.7		
1936..	Wyandot .	.06		15.2		
1938..	Logan ...	.77*		16.6	.40	9.0
1938..	Marion ...		.47	16.6	.46	4.1
1938..	Miami ...					12.4
1938..	Putnam ..					5.5
1938..	Wyandot .	.06		17.3	.64	4.8
1941..	Wyandot .	.05		12.4		4.8

* Slightly larger yield due to pollination by thrip insects.

Utilization of Honeybees Solution to Pollination Problem

Experimental studies conducted by the Department of Entomology, Ohio Agricultural Experiment Station, show that seed yields are directly correlated with the density of the honeybee population.

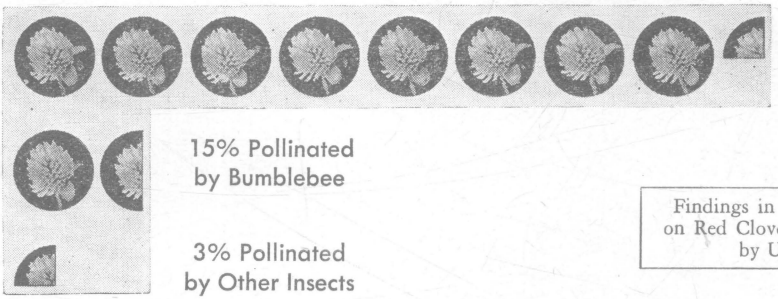
The Station's experimental data relating to alsike seed yields can be taken as a general index of what will occur with the self-sterile group of legumes (see Table 1).

Because of the general impression that honeybees do not pollinate red clover, the

data from Henry County in Figure 2 are presented as typical of the significance of the honeybee as a pollinating agent.

Extensive studies were carried on over a 3-year period involving detailed observations in fields of red clover for each day of the second blooming period. The pollination of red clover by honeybees is incidental to the collection of large quantities of pollen, and nectar in small amounts. Of the 28 kinds of pollinating insects collected during a 3-year period, studies showed that more than four-fifths of the total pollination services were performed by honeybees.

Fig. 2.—Who Actually Does the Work on Red Clover Bloom?



Providing an Adequate Honeybee Population

Since the pollinating services from honeybees is free, the density of the bee population will be determined by the number of colonies that the community will support for profitable honey production. A commercial yard of bees, that is, 60 to 100 colonies of bees in one location, is about as dense a population as can be expected. A farmer having a commercial yard of bees on his farm and farmers close to bee yards should find the growing of legume seed very profitable.

If all farmers would take advantage of establishing bee yards it would be the most effective means of "stepping up" legume seed production (See Table 1). A farmer desiring to increase his legume seed yields, but who lacks the necessary pollinating insect force, could, in many cases, correct this limiting factor by offering a free apiary site as a special inducement to a beekeeper to establish a yard of bees on his farm. When colonies of bees are moved on a farm for legume pollination, it should be done previous to the blossoming of the clovers.

In areas where there are no commercial yards of bees, a farmer is encouraged to own whatever number of colonies he can profitably care for. Farmer beekeepers should produce extracted honey, because larger populated colonies are assured, less skilled labor required, and larger honey yields result than when bees are managed for comb honey. On the glaciated limestone soils a colony will average 50 to 100 pounds of extracted honey annually (see Extension bulletin 159 for details). While this honeybee population may be inadequate to do a good job of legume pollination, nevertheless, a sizeable increase in seed yields would result over yields where natural pollinating insects alone were depended on for pollination.

For purposes of heavy seed production it may be desirable to increase the honeybee population to a degree where honey production becomes unprofitable. Such a program would necessitate the renting of colonies of bees during the blooming period of legumes, and *might involve as many as four to six colonies per acre.* Such a heavy concentration of honeybees would be especially desirable in cases where it seems highly important to make superior strains of legume seed rapidly available to farmers.

Competition of Blooming Plants for Insect Visitors Influences Seed Yields

Keen competition exists between blooming legume plants for the visits of pollinating insects These insects generally confine the bulk of their activity to the blossoms secreting the sweetest nectar This explains largely why seed sets may be poor on some clovers while on other varieties the seed set is extremely heavy during the same season Competition between the fields of a given variety of clover will also vary due to genetic differences between strains to produce nectar, to different soil types, and to variation in the soil moisture of the fields

Alsike clover normally competes well for pollinating insects White Dutch, yellow and white sweet clovers are the chief competitors of alsike clover bloom White sweet clover usually competes better for insect visitors than does yellow sweet clover The second or third bloom of alfalfa which is usually saved for seed normally blossoms at a time when other clover bloom is not so plentiful During dry seasons honeybees work alfalfa blossoms intensively. Red clover seed in Ohio is produced from the second bloom This blossoming period usually occurs when there is a scarcity of forage plants for honeybees Honeybees work red clover heavily for pollen and also obtain nectar in small amounts

Other Limitations to High Clover Seed Yields

Unbelievably high seed yields experienced in irrigated areas of the West have caused considerable speculation concerning the reasons for success or failure in clover seed production The newly irrigated areas invariably produce high seed yields for a few years Thereafter, yields fluctuate, but usually average less than those obtained during the first few years after the introduction of the enterprise These reductions in seed yields are largely the result of two important changes in the insect populations (1) A decrease in wild bees that perform the pollinating services, (2) an increase in the number of destructive insects that reduce the vigor of the seed producing plants, or render those plants unattractive to the pollinating insects

The injury through feeding of insects affects the vitality of the plants thereby preventing growth of seed Since modern methods of controlling destructive insects in clover fields are in an evolutionary state, the Extension entomologist, or the county agricultural agent should be consulted for recommendations

Cloudy, wet weather during the blooming period discourages the activity of pollinating insects Low seed yields usually follow.

Unadapted and disease susceptible clover varieties may also produce disappointing yields even when other conditions are favorable.

Conclusions

1 Farmers located within ¼ to 1½ miles from 60 to 100 colonies of honeybees should find seed production very profitable.
2 Farmers wishing to grow clover seed but needing honeybees near their fields can induce a commercial beekeeper to move a yard of bees to his farm by offering a free apiary site.
3. Seed growers desiring the highest seed yields should rent 4 to 6 colonies of bees for each acre of legume bloom
4. The county agricultural agent can give valuable assistance to farmers regarding the nearness of commercial yards of bees to their farms.

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